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THE DARWINISM OF DARWIN, AND OF THE POST-DARWINIAN SCHOOLS.[1]

I PROPOSE in this article to take a brief survey of the general theory of descent, first, as this was held by Darwin himself, and next, as it is now held by the several divergent schools of thought which have arisen since Darwin's death.

The most important of the questions in debate is one which I have already had occasion to mention, while dealing, in historical order, with the objections that were brought against the theory of natural selection during the life-time of Darwin.[2] Here, however, we must consider it somewhat more in detail, and justify by quotation what was previously said regarding the very definite nature of his utterances upon the matter. This question is whether natural selection has been the sole, or but the main, cause of organic evolution.

Must we regard survival of the fittest as the one and only principle which has been concerned in the progressive modification of living forms, or are we to suppose that this great and leading principle has been assisted by other and subordinate principles, without the co-operation of which the results, as presented in the animal and vegetable kingdoms, could not have been effected? Now Darwin's answer to this question was distinct and unequivocal. He stoutly resisted the doctrine that natural selection was to be regarded as the only cause of organic evolution. On the other hand, this opinion was—and still continues to be—persistently maintained by Mr. Wallace;[1] and it constitutes the source of all the differences between his views and those of Darwin. Moreover, up to the time of Darwin's death, Mr. Wallace was absolutely alone in maintaining this opinion: the whole body of scientific thought throughout the world being against him; for it was deemed improbable that, in the enormously complex and endlessly varied processes of organic evolution, only a single principle should be everywhere and exclusively concerned.[2] But since Darwin's death there has been a great revolution of biological thought in favor of Mr. Wallace's opinion. And the reason for this revolution has been, that his doctrine of natural selection as the sole cause of organic evolution has received the corroborative support of Professor Weismann's theory of heredity—which has been more or less cordially embraced by a certain section of evolutionists, and which appears to carry the doctrine in question as a logical corollary, so far, at all events, as adaptive structures are concerned.

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[1] From a forthcoming volume on *Post-Darwinian Questions*, being Part II. of *Darwin and After Darwin*, edited by Prof. C. Lloyd Morgan. Copyright in the United States by The Open Court Publishing Co.; in England, by Messrs. Longman & Co.

[2] *The Darwinian Theory*, pp. 253–256.

Now in this article we shall have to do merely with a setting forth of Darwin's opinion: we are not considering how far that opinion ought to be regarded as having been in any measure displaced by the results of more recent progress. Such, then, being the only matter which here concerns us, I will supply a few brief quotations, to show how unequivocally Darwin has stated his views.

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[1] "It is a misfortune attending the aim and scope of Part II. that they bring me into frequent discord with one or other of the most eminent of Post-Darwinian writers—especially with Mr. Wallace. But such is the case only because the subject-matter of this volume is avowedly restricted to debatable topics, and because I choose those naturalists who are deservedly held in most esteem to act spokesmen on behalf of such Post-Darwinian views as appear to me doubtful or erroneous. Obviously, however, differences of opinion on particular points ought not to be taken as implying any failure on my part to recognise the general scientific authority of these men, or any inability to appreciate their labors in the varied fields of Biology."—Quoted from the Preface of *Post-Darwinian Questions*.—Ed.

[2] *Contributions to the Theory of Natural Selection*, p. 47.

First, we may take what he says upon the "Lamarckian factors";[1] and next we may consider what he says with regard to other factors, or, in general, upon natural selection not being the sole cause of organic evolution.

"Changed habits produce an inherited effect, as in the period of the flowering of plants when transported from one climate to another. With animals the increased use or disuse of parts has had a more marked influence."[2]

"There can be no doubt, from the facts given in this chapter, that extremely slight changes in the conditions of life sometimes, probably often, act in a definite manner on our domesticated productions; and, as the action of changed conditions in causing indefinite variability is accumulative, so it may be with their definite action. Hence considerable and definite modifications of structure probably follow from altered conditions acting during long series of generations."[3]

"How, again, can we explain the inherited effects of the use and disuse of particular organs? The domesticated duck flies less and walks more than the wild duck, and its limb bones have become diminished and increased in a corresponding manner in comparison with those of the wild duck. A horse is trained to certain paces, and the colt inherits similar consensual movements. The domesticated rabbit becomes tame from close confinement; the dog, intelligent from associating with man; the retriever is taught to fetch and carry; and these mental endowments and bodily powers are all inherited. Nothing in the whole circuit of physiology is more wonderful. How can the use or disuse of a particular limb or of the brain affect a small aggregate of reproductive cells, seated in a distant part of the body, in such a manner that the being developed from these cells inherits the characters of either one or both parents? . . . In the chapters devoted to inheritance, it was shown that a multitude of newly acquired characters, whether injurious or beneficial, whether of the lowest or highest vital importance, are often faithfully transmitted.[4]"

"When discussing special cases, Mr. Mivart passes over the effects of the increased use and disuse of parts, which I have always maintained to be highly important, and have treated in my 'Variation under Domestication' at greater length than, as I believe, any other writer.[5]"

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[1] So far as we shall be concerned with them throughout this treatise, the "Lamarckian factors" consist in the supposed transmission of acquired characters, whether the latter be due to the direct influence of external conditions of life on the one hand, or to the inherited effects of use and disuse on the other. For the phrase "inherited effects of use and disuse," I shall frequently employ the term "use-inheritance," which has been coined by Mr. Platt Ball as a more convenient expression.

[2] *Origin of Species*, 6th Ed., p. 8.

[3] *Variation* etc., 2nd Ed., II., p. 280.

[4] *Variation* etc., II., p. 367.

[5] *Origin of Species*, p. 176.

So much for the matured opinion of Darwin touching the validity of the theory of use-inheritance. Turning now to his opinion on the question whether or not there are yet any further factors concerned in the process of organic evolution, I think it will be sufficient to quote a single passage from the *Origin of Species.* The first paragraph of the "Conclusion" is devoted to a *résumé* of his views upon this matter, and consists of the following most emphatic words.

> "I have now recapitulated the facts and considerations which have thoroughly convinced me that species have been modified, during a long course of descent. This has been effected chiefly through the natural selection of numerous successive, slight, favorable variations; aided in an important manner by the inherited effects of the use and disuse of parts; and in an unimportant manner, that is, in relation to adaptive structures, whether past or present, by the direct action of external conditions, and by variations which seem to us in our ignorance to arise spontaneously. It appears that I formerly underrated the frequency and value of these latter forms of variation, as leading to permanent modifications of structure independently of natural selection. But as my conclusions have lately been much misrepresented, and it has been stated that I attribute the modification of species exclusively to natural selection, I may be permitted to remark that in the first edition of this work, and subsequently, I placed in a most conspicuous position—namely, at the close of the Introduction—the following words: 'I am convinced that natural selection has been the main, but not the exclusive means of modification.' This has been of no avail. Great is the power of steady misrepresentation; but the history of science shows that fortunately this power does not long endure."

In the whole range of Darwin's writings there cannot be found a passage so strongly worded as this: it presents the only note of bitterness in all the thousands of pages which he has published. Therefore I do not think it is necessary to supply any further quotations for the purpose of proving the state of his opinion on the point in question. But, be it carefully noted, from this great or radical difference of opinion between the joint originators of the theory of natural selection, all their other differences of opinion arise; and seeing that since the death of Darwin a large number of naturalists have gone over to the side of Wallace, it seems desirable here to state categorically what these other or sequent points of difference are. Without at present discussing them, therefore, I will merely set them out in a tabular form, in order that a clear perception may be gained of their logical connexion with this primary point of difference.

The theory of Natural Selection according to Darwin.	*The theory of Natural Selection according to Wallace.*
Natural Selection has been the main means of modification, not excepting the case of Man.	Natural Selection has been the sole means of modification, excepting in the case of Man.
a. Therefore it is a question of evidence whether the Lamarckian factors have co-operated.	*a.* Therefore it is antecedently impossible that the Lamarckian factors can have co-operated.
b. Neither all species, nor *a fortiori*, all specific characters, have been due to natural selection.	*b.* Not only all species, but all specific characters, must necessarily have been due to natural selection.
c. Thus the principle of Utility is not of universal application, even where species are concerned.	*c.* Thus the principle of Utility must necessarily be of universal application, where species are concerned.
d. Thus, also, the suggestion as to Sexual Selection, or any other supplementary cause of modification, may be entertained; and, as in the case of the Lamarckian factors, it is a question of evidence whether, or how far, they have co-operated.	*d.* Thus, also, the suggestion as to Sexual Selection, or of any other supplementary cause of modification, must be ruled out; and, as in the case of the Lamarckian factors, their co-operation deemed impossible.
e. No detriment arises to the theory of natural selection as a theory of the origin of species by entertaining the possibility, or the probability, of supplementary factors.	*e.* The possibility — and, a *fortiori* the probability—of any supplementary factors cannot be entertained without serious detriment to the theory of natural selection, as a theory of the origin of species.
f. Cross-sterility in species cannot possibly be due to natural selection.	*f.* Cross-sterility in species is probably due to natural selection.[1]

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[1] This, to the best of my judgment, is the fairest extract that I can give of Mr. Wallace's most recently published opinions on the points in question. [In particular as regards *a*, see *Darwinism*, pp. 435–436.] But with regard to some of them, his expression of opinion is not always consistent. Besides, I am here taking Mr. Wallace as representative of the Neo-Darwinian school, one or other prominent member of which has given emphatic expression to each of the above propositions.

As it will be my endeavor in my forthcoming book to consider the rights and the wrongs of these antithetical propositions, I may reserve further quotations from Darwin's works, which will show that the above is a correct epitome of his views as contrasted with those of Wallace and the Neo-Darwinian school of Weismann. But here, where the object is merely a statement of Darwin's theory touching the points in which it differs from those of Wallace and Weismann, it will be sufficient to set forth these points of difference in another and somewhat fuller form. So far then as we are at present concerned, the following are the matters of doctrine which have been clearly, emphatically, repeatedly, and uniformly expressed throughout the whole range of Darwin's writings.

1. That natural selection has been the main means of modification.

2. That, nevertheless, it has not been the only means; but has been supplemented or assisted by the co-operation of other causes.

3. That the most "important" of these other causes has been the inheritance of functionally-produced modifications (use-inheritance), but this only because the transmission of such modifications to progeny must always have had immediate reference to *adaptive* ends, as distinguished from merely useless change.

4. That there are sundry other causes which lead to merely useless change—in particular, "the direct action of external conditions, and variations which seem to us in our ignorance to arise spontaneously."

5. Hence, that the "principle of utility," far from being of universal occurrence in the sphere of animate nature, is only of what may be termed highly general occurrence; and, therefore, that certain other advocates of the theory of natural selection were mistaken in representing the universality of this principle as following by way of necessary consequence from that theory.

6. Cross-sterility in species cannot possibly be due to natural selection: but everywhere arises as a result of some physiological change having exclusive reference to the sexual system—a change which is probably everywhere due to the same cause, although what this cause could be Darwin was confessedly unable to suggest.

Such, then, was the theory of evolution as held by Darwin, so far as the points at present before us are concerned. And, it may now be added, that the longer he lived, and the more he pondered these points, the less exclusive was the rôle which he assigned to natural selection, and the more importance did he attribute to the supplementary factors above named. This admits of being easily demonstrated by comparing successive editions of his works; a method adopted by Mr. Herbert Spencer in his essay on the *Factors of Organic Evolution.*

My object in thus clearly defining Darwin's attitude regarding these sundry points is twofold.

In the first place, with regard to merely historical accuracy, it appears to me undesirable that naturalists should endeavor to hide certain parts of Darwin's teaching, and give undue prominence to others. In the second place, it appears to me still more undesirable that this should be done—as it usually is done—for the purpose of making it appear that Darwin's teaching did not really differ very much from that of Wallace and Weismann on the important points in question. I myself believe that Darwin's judgment with regard to all these points will eventually prove more sound and accurate than that of any of the recent would-be improvers upon his system; but even apart from this opinion of my own, it is undesirable that Darwin's views should be misrepresented, whether the misrepresentation be due to any unfavorable bias against one side of his teaching, or to sheer carelessness in the reading of his books. Yet the new school of evolutionists, to which allusion has now so frequently been made, speak of their own modifications of Darwin's teaching as "pure Darwinism," in contradistinction to what they call "Lamarckism." In other words, they represent the principles of "Darwinism" as standing in some kind of opposition to those of "Lamarckism": the Darwinian principle of natural selection, they think, is in itself enough to account for all the facts of adaptation in organic nature. Therefore they are eager to dispense with the Lamarckian principle of the inherited effects of use and disuse, together with the direct influence of external conditions of life, and all or any other causes of modification which either have been, or in the future may possibly be, suggested. Now, of course, there is no reason why any one should not hold these or any other opinions to which his own independent study of natural science may lead him; but it appears to me that there is the very strongest reason why any one who deviates from the carefully formed opinions of such a man as Darwin should above all things be careful to be absolutely fair in his representations of them; he should be scrupulously jealous, so to speak, of not letting it appear that he is unjustifiably throwing over his own opinions the authority of Darwin's name.

But in the present case, as we have seen, not only do the Neo-Darwinians strain the teachings of Darwin; they positively reverse those teachings—representing as anti-Darwinian the whole of one side of Darwin's system, and calling those who continue to accept that system in its entirety by the name "Lamarckians." I know it is sometimes said by members of this school, that in his utilisation of Lamarckian principles as accessory to his own, Darwin was actuated by motives of "generosity." But a more preposterous suggestion could not well be made. We may fearlessly challenge any one who speaks or writes in such a way, to show any other instance where Darwin's great generosity of disposition had the effect of influencing by one hair's breadth his still greater loyalty to truth. Moreover, and with special regard to this particular case, I would point out that in no one of his many allusions to, and often lengthy discussions of, these so-called Lamarckian principles, does he ever once introduce the name of Lamarck; while, on the other hand, in the only places where he does so—whether in his books or in his now published letters—he does so in order to express an almost contemptuous dissatisfaction, and a total absence of obligation. Hence, having regard to the "generosity" with which he always acknowledged obligations, there can be no reasonable doubt that Darwin was not in the smallest degree influenced by the speculative writings of Lamarck; or that, even if Lamarck had never lived, the *Origin of Species* would have differed in any single particular from the form in which it now stands. Finally, it must not be forgotten that Darwin's acceptance of the theory of use-inheritance was vitally essential to his theory of Pangenesis—that "beloved child" over which he had "thought so much as to have lost all power of judging it."[1]

What has just been said touching the relations between Darwin's theory and that of Lamarck, applies with equal force to the relations between Darwin's theory and any other theory appertaining to evolution which has already been, or may hereafter be propounded. Yet so greatly have some of the Neo-Darwinians misunderstood the teachings of Darwin, that they represent as "Darwinian heresy" any suggestions in the way of factors "supplementary to," or "co-operative with" natural selection. Of course, if these naturalists were to avow themselves followers of Wallace, instead of followers of Darwin, they would be perfectly justified in repudiating any such suggestions as *ipso facto* heretical. But, as we have now seen, through all his life Darwin differed from Wallace with regard to this very point; and therefore, unlike Wallace, he was always ready to entertain "additional suggestions" regarding the causes of organic evolution—several of which, indeed, he himself supplied. Hence we arrive at this curious state of matters. Those biologists who of late years have been led by Weismann to adopt the opinions of Wallace, represent as anti-Darwinian the opinions of other biologists who still adhere to the unadulterated doctrines of Darwin. Weismann's *Essays on Heredity* (which argue that natural selection is the only possible cause of adaptive modification) and Wallace's work on *Darwinism* (which in all the respects where any charge of "heresy" is concerned directly contradicts the doctrine of Darwin) —these are the writings which are now habitually represented by the Neo-Darwinians as setting forth the views of Darwin in their "pure" form. The result is that, both in conversation and in the press, we habitually meet with complete inversions of the truth, which show the state of confusion into which a very simple matter has been wrought by the eagerness of certain naturalists to identify the views of Darwin with those of Wallace and Weismann. But we may easily escape this confusion, if we remember that wherever in the writings of these naturalists there occur such phrases as "pure

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[1] *Life and Letters*, Vol. III., pp. 72 and 75.

Darwinism" we are to understand pure *Wallaceism*, or the pure theory of natural selection to the exclusion of any supplementary theory. Therefore it is that for the sake of clearness I coined, several years ago, the terms "Neo-Darwinian" and "Ultra-Darwinian" whereby to designate the school in question.

So much, then, for the Darwinism of Darwin, as contrasted with the Darwinism of Wallace, or, what is the same thing, of the Neo-Darwinian school of Weismann. Next we may turn, by way of antithesis, to the so-called "Neo-Lamarckian" school of the United States. For, by a curious irony of fate while the Neo-Darwinian school is in Europe seeking to out-Darwin Darwin by assigning an exclusive prerogative to natural selection in both kingdoms of animate nature, the Neo-Lamarckian school is in America endeavoring to reform Darwinism in precisely the opposite direction—viz. by transferring the sovereignty from natural selection to the principles of Lamarck. Without denying to natural selection a more or less important part in the process of organic evolution, members of this school believe that much greater importance ought to be assigned to the inherited effects of use and disuse than was assigned to these agencies by Darwin. Perhaps this noteworthy state of affairs, within a decade of Darwin's death, may lead us to anticipate that his judgment—standing, as it does, between these two extremes—will eventually prove the most accurate of all, with respect to the relative importance of these factors of evolution. But, be this as it may, I must now offer a few remarks upon the present position of the matter.

In the first place, to any one who (with Darwin and against Weismann) admits not only the abstract possibility, but an actual working, of the Lamarckian factors, it becomes difficult to determine, even approximately, the degrees of value which ought to be ascribed to them and to natural selection respectively. For, since the results are in both cases identical in kind (as, adaptive changes of organic types), where both sets of causes are supposed to be in operation together, we have no means of estimating the relative shares which they have had in bringing about these results. Of course there are large numbers of cases where it cannot possibly be supposed that the Lamarckian factors have taken any part at all in producing the observed effects; and therefore in such cases there is almost full agreement among evolutionists in theoretically ascribing such effects to the exclusive agency of natural selection. Of such, for instance, are the facts of protective coloring, of mimicry, of the growth of parts which, although *useful*, are never *active* (e. g. shells of mollusks, hard coverings of seeds), and so on. But in the majority of cases where adaptive structures are concerned, there is no means of discriminating between the influences of the Lamarckian and the Darwinian factors. Consequently, if by the Neo-Lamarckian school we understand all those naturalists who assign any higher importance to the Lamarckian factors than was assigned to them by Darwin, we may observe that members of this school differ very greatly among themselves as to the degree of importance that ought to be assigned. On the one hand we have, in Europe, Giard, Perrier, and Eimer, who stand nearer to Darwin than do a number of the American representatives—of whom the most prominent are Cope, Osborn, Packard, Hyatt, Brooks, Ryder, and Dall. The most extreme of these is Professor Cope, whose collection of essays entitled *The Origin of the Fittest*, as well as his more recent and elaborate monograph on *The Development of the Hard Parts of the Mammalia* represent what appears even to some other members of his school an extravagant estimate of the importance of Lamarckian principles.

But the most novel, and in many respects the most remarkable school of what may be termed Anti-selectionists is one which is now (1894) rapidly increasing both in numbers and in weight, not only in the New World, but also in Germany, and to a lesser extent, in Great Britain.

This school, without being either Lamarckian or Darwinian (for its individual members differ widely from one another in these respects) maintains a principle which it deems of more importance than either use-inheritance or natural selection. This principle it calls Self-adaptation. It is chiefly botanists who constitute this school, and its principal representatives, in regard to authority, are Sachs, Pfeffer and Henslow.

Apart from topics which are to be dealt with in my book, the only matters of much importance which have been raised in the Post-Darwinian period are those presented by the theories of Geddes, Cope, Hyatt, and others, and certain more or less novel ideas set forth in Wallace's *Darwinism*.

Mr. Geddes has propounded a new theory of the origin of species, which in his judgment supersedes to a large extent the theory of natural selection. He has also, in conjunction with Mr. Thomson, propounded a theory of the origin of sex. For my own part, I cannot see that these views embody any principles or suggestions of a sufficiently definite kind to constitute them theories at all. In this respect the views of Mr. Geddes resemble those of Professors Cope, Hyatt, and others, on what they term "the law of acceleration and retardation." In all these cases, so far as I can see, the so-called explanations are not in fact any explanations; but either are a mere re-statement of the facts, or else an enunciation of more or less meaningless propositions. Thus, when it is said that the evolution of any given type has been due to the "acceleration of growth-force" with respect to some structures, and the "retardation of growth-force" with respect to others, it appears evident that we have not any real explanation in terms of causality; we have only the form of an explanation in the terms of a proposition. All that has been done is to express the fact of evolution in somewhat obscure phraseology, since the very thing we want to know about this fact is—What are the causes of it as a fact or the reasons which have led to the increase of some of the parts of any given type and the concomitant decrease of others? It is merely the facts themselves that are again presented by saying that the development has been in the one case accelerated, while in the other it has been retarded.[1]

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[1] Take, for example, the following which is a fair epitome of the whole:—"I believe that this is the simplest mode of stating and explaining the law of variation; that some forms acquire something which their parents did not possess; and that those which acquire something additional have to pass through more numerous stages than their ancestors; and those which lose something pass through fewer stages than their ancestors; and these processes are expressed by the terms "acceleration" and "retardation." (*Origin of the Fittest*, pp. 125, 226, and 297.) Even

So much for what may be termed this New World theory of the origin of species: it is a mere re-statement of the facts. Mr. Geddes's theory, on the other hand, although more than a mere re-statement of the facts, appears to me too vague to be of any explanatory service. His view is that organic evolution has everywhere depended upon an antagonism, within the limits of the same organism, between the processes of nutrition and those of reproduction. But although he is thus able hypothetically to explain certain facts—such as the shortening of a flower-spike into a composite flower—the suggestion is obviously inadequate to meet, even hypothetically, most of the facts of organic evolution, and especially the development of *adaptive* structures. Therefore it seems to me, we may dismiss it even as regards the comparatively few facts which it might conceivably explain—seeing that these same facts may be equally well explained by the causes which are already known to operate in other cases. For it is the business of natural selection to ensure that there shall nowhere be any needless expenditure of vital energy, and, consequently, that everywhere the balance between nutrition and reproduction shall be most profitably adjusted.

Similarly with respect to the theory of the *Origin of Sex*, I am unable to perceive even this much of scientific relevancy. As stated by its authors, the theory is that the female is everywhere "anabolic," as compared with the male, which is "katabolic." By anabolic is meant comparative inactivity of protoplasmic change due to a nutritive winding up of molecular constitution, while by katabolic is meant the opposite condition of comparative activity due to a dynamic running down of molecular constitution. How, then, can the *origin* of sex be explained, or the *causes* which led to the differentiation of the sexes be shown, by saying that the one sex is anabolic and the other katabolic? In so far as these verbal statements serve to express what is said to be a general fact—namely, that the female sexual elements are less mobile than the male—they merely serve to re-state this general fact in terminology which, as

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if this be "the simplest mode of *stating* the law of variation," it obviously does nothing in the way of *explaining* the law.

the authors themselves observe, is "unquestionably ugly." But in so far as any question of *origin* or *causality* is concerned, it appears to me that there is absolutely no meaning in such statements. They belong to the order of merely formal explanations, as when it is said that the toxic qualities of morphia are due to this drug possessing a soporific character.

Much the same, in my opinion, has to be said of the Rev. G. Henslow's theory of the origin of species by what he terms "self-adaptation." Stated briefly, his view is that there is no sufficient evidence of natural selection as a *vera causa*, while there is very abundant evidence of adjustments occurring without it, first in individual organisms, and next by inheritance of acquired characters, in species. Now, much that he says in criticism of the selection theory is of considerable interest as such; but when we pass from the critical to the constructive portions of his books and papers, we again meet with the want of clearness in thought between a statement of facts in terms of a proposition, and an explanation of them in those of causality. Indeed, I understand from private correspondence, that Mr. Henslow himself admits the validity of this criticism; for in answer to my questions,—"How does self-adaptation work in each case, and why should protoplasm be able to *adapt itself* into the millions of diverse mechanisms in nature?"—he writes, "Self-adaptation does not profess to be a *vera causa* at all; for the true causes of variation can only be found in the answer to your [above] questions, and I must say at once, *these questions cannot be answered.*" That is, they cannot be answered on the hypothesis of self-adaptation, which is therefore a statement of the facts of adaptation as distinguished from an explanation of them. Nevertheless, two things have here to be noted. In the first place, the statement of facts which Mr. Henslow has collected is of considerable theoretical importance as tending to show that there are probably causes of an internal kind (i. e., other than natural selection) which have been largely concerned in the adaptive modification of plants. And, in the second place, it is not quite true that the theory of self-adaptation is, as its author says in the sentences above quoted, a mere statement of the facts of adaptation, without any attempt at explaining their causes. For in his published words he does attempt to do so.[1] And, although I think his attempt is a conspicuous failure, I ought in fairness to give examples of it. His books are almost exclusively concerned in an application of his theory to the mechanisms of flowers for securing their own fertilisation. These mechanisms he ascribes, in the case of entomophylous flowers, to the "thrusts," "strains," and other "irritations" supplied to the flowers by their insect visitors, and consequent "reactions" of the vegetable "protoplasm." But no attempt is made to show why these "reactions" should be of an *adaptive* kind, so as to build up the millions of diverse and often elaborate mechanisms in question—including not only forms and movements, but also colors, odors, and secretions. For my own part I confess that, even granting to an ultra-Lamarckian extent the inheritance of acquired characters, I should conceive of "self-adaptation" alone producing all such innumerable and diversified adjustments only after seeing, with Cardinal Newman, an angel in every flower. Yet Mr. Henslow somewhat vehemently repudiates any association between his theory and that of teleology.

On the whole, then, I regard all the works which are here classed together (those by Cope, Geddes, and Henslow) as resembling one another both in their merits and defects. Their common merits lie in their erudition and much of their criticism, while their common defects consist on the one hand in not sufficiently distinguishing between mere statements and real explanations of facts, and, on the other, in not perceiving that the theories severally suggested as substitutes for that of natural selection, even if they be granted true, could be accepted only as co-operative factors, and by no stretch of logic as substitutes.

Turning now to Mr. Wallace's work on *Darwinism*, we have to notice, in the first place, that its doctrine differs from "Darwinism" in regard to the important dogma which it is the leading purpose of that work to sustain—namely, that "the law of utility" is, to all intents and purposes, universal, with the result that natural selection is virtually the only cause of organic evolution. I say, "to all intents and purposes" or "virtually," because Mr. Wallace does not expressly maintain the abstract impossibility of laws and causes other than those of utility and natural selection ; indeed, at the end of his treatise he quotes with approval Darwin's judgment, that "natural selection has been the most important, but not the exclusive means of modification." Nevertheless, as he nowhere recognises any other law or cause of adaptive evolution,[1] he practically concludes that, on inductive or empirical grounds, there *is* no such other law or cause to be entertained—until we come to the particular case of the human mind. But even in making this one particular exception—or in representing that some other law than that of utility, and some other cause than that of natural selection, must have been concerned in evolving the mind of man—he is not approximating his system to that of Darwin. On the contrary, he is but increasing the divergence, for, of course, it was Darwin's view that no such exception could be legitimately drawn with respect to this particular instance. And if, as I understand must be the case, his expressed agreement with Darwin touching natural selection not being the only cause of adaptive evolution has reference to this point, the quotation is singularly inapt.

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[1] *Floral Structures* (International Science Series, LXIV., 1888); *The Making of Flowers* (Romance of Science Series, 1891); and Linn. Soc. Papers, 1893–1894.

Looking, then, to these serious differences between his own doctrine of evolution—both organic and mental—and that of Darwin, I cannot think that Mr. Wallace has chosen a suitable title for his book ; because, in view of the points just mentioned, it is unquestionable that *Darwinism* differs more widely from the *Origin of Species* than does the *Origin of Species* from the writings of the Neo-Lamarckians. But, passing over this merely nominal matter, a few words ought to be added on the very material question regarding the human mind. In my book the more general question, or that which relates to the range of utility and natural selection elsewhere will be fully considered.

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[1] "The law of correlation," and the "laws of growth," he does recognise ; and shows that they furnish an explanation of the origin of many characters, which cannot be brought under "the law of utility."

Mr. Wallace says :

> "The immense interest that attaches to the origin of the human race, and the amount of misconception which prevails regarding the essential teachings of Darwin's theory on the question, as well as regarding my own special views upon it, induce me to devote a final chapter to its discussion."

Now I am not aware that there is any misconception in any quarter as to the essential teachings of Darwin's theory on this question. Surely it is rather the case that there is a very general and very complete understanding on this point, both by the friends and the foes of Darwin's theory—so much so, indeed, that it is about the only point of similar import in all Darwin's writings of which this can be said. Mr. Wallace's "special views" on the other hand are, briefly stated, that certain features, both of the morphology and the psychology of man, are inexplicable by natural selection—or indeed by any other cause of the kind ordinarily understood by the term natural: they can be explained only by supposing "the intervention of some distinct individual intelligence," which, however, need not necessarily be "one Supreme Intelligence," but some other order of Personality standing anywhere in "an infinite chasm between man and the Great Mind of the universe."[1] Let us consider separately the corporeal and the mental peculiarities which are given as justifying this important conclusion.

The bodily peculiarities are the feet, the hands, the brain, the voice, and the naked skin.

As regards the feet Mr. Wallace writes, "It is difficult to see why the prehensile power [of the great toe] should have been taken away," because, although "it may not be compatible with perfectly easy erect locomotion," "how can we conceive that early man, *as an animal*, gained anything by purely erect locomotion?"[2] But surely it is not difficult to conceive this. In the proportion that our simian progenitors ceased to be arboreal in their habits (and there may well have been very good utilitarian reasons for such a change of habitat, analogous to those which are known to have occurred in the phylogenesis of countless other animals), it would clearly have been of advantage to them that their already semi-erect attitude should have been rendered more and more erect. To name one among several probabilities, the more erect the attitude, and the more habitually it was assumed, the more would the hands have been liberated for all the important purposes of manipulation. The principle of the physiological division of labor would thus have come more and more into play: natural selection would therefore have rendered the upper extremities more and more suited to the execution of these purposes, while at the same time it would have more and more adapted the lower ones to discharging the sole function of locomotion. For my own part, I cannot perceive any difficulty about this: in fact, there is an admirable repetition of the process in the ontogeny of our own children.[1]

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[1] *Natural Selection and Tropical Nature*, 1891, p. 205.

[2] *Ibid.*, pp. 197 198.

Next, with regard to the hand, Mr. Wallace says, that it "contains latent capacities which are unused by savages and must have been even less used by palæolithic man and his still ruder predecessors." Thus, "it has all the appearance of an organ prepared for the use of civilised man."[2] Even if this be true, however, it would surely be a dangerous argument to rely upon, seeing that we cannot say of how much importance it may have been for early man—or even apes—to have had their power of manipulation progressively improved. But is the statement true? It appears to me that if Mr. Wallace had endeavored to imitate the manufactures that were practised by "palæolithic man," he would have found the very best of reasons for cancelling his statement. For it is an extremely difficult thing to chip a flint into the form of an arrow-head: when made, the suitable attachment of it to a previously prepared arrow is no easy matter: neither a bow nor a bow-string could have been constructed by hands of much less perfection than our own: and the slaying of game with the whole apparatus, when it has been constructed, requires a manual dexterity which we may be perfectly certain that Mr. Wallace—unless he has practised the art from boyhood—does not possess.

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[1] For an excellent discussion on the ontogeny of the child in this connexion see *Some Laws of Heredity*, by Mr. S. S. Buckman, pp. 290, et seq. (*Proc. Cotteswold Nat. Field Club*, Vol. X., p. 3, 1892).

[2] *Loc. cit.*, p. 198.

So it is with his similar argument that the human voice is more "powerful," more "flexible," and presents a greater "range" and "sweetness" than the needs of savage life can be held to require. The futility of this argument is self-evident as regards "power." And although its weakness is not so obvious with respect to the other three qualities which are named, need we go further than the closely analogous case of certain birds to show the precariousness of arguing from such facts of organic nature to the special operation of "a superior intelligence"? I can hardly suppose that Mr. Wallace will invoke any such agency for the purpose of explaining the "latent capacities" of the voice of a parrot. Yet, in many respects, these are even more wonderful than those of the human voice, albeit in a wild state they are "never required or used."[1]

Once more, with regard to the naked skin, it seems sufficient to quote the following passage from the first edition of the *Descent of Man*:

> "The Rev. T. R. Stebbing, in commenting on this view, remarks, that had Mr. Wallace 'employed his usual ingenuity on the question of man's hairless skin, he might have seen the possibility of its selection through its superior beauty, or the health attaching to superior cleanliness. At any rate it is surprising that he should picture to himself a superior intelligence plucking the hair from the backs of savage men (to whom, according to his own account, it would have been useful and beneficial), in order that the descendants of the poor shorn wretches might, after many deaths from cold and damp in the course of many generations,' have been forced to raise themselves in the scale of civilisation through the practice of various arts, in the manner indicated by Mr. Wallace."[2]

To this it may be added that the chimpanzee "Sally" was largely denuded of hair, especially on the back, or the part of

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[1] For a discussion of this remarkable case, see *Mental Evolution in Animals*, pp. 222–223. It appears to me that if Mr. Wallace's argument from the "latent capacities of the voice of Man" is good for anything, *a fortiori* it must be taken to prove that, in the case of the parrot, "the organ has been prepared in anticipation" of the amusement which the cultivation of its latent capacities arouses in "civilised man."

[2] *Descent of Man*, 1st Ed., Ch. XX. (Trans. Dev. Assoc. for Science, 1890).

"man's organisation" on which Mr. Wallace lays special stress, as being in this respect out of analogy with other mammalia.[1]

Lastly, touching his statement that the brain of savage man is both quantitatively and qualitatively in advance of his requirements, it is here also sufficient to refer to Darwin's answer, as given in the *Descent of Man.* Mr. Wallace, indeed, ignores this answer in his recent re-publication of the argument; but it is impossible to understand why he should have done so. To me, at all events, it seems that one out of several considerations which Darwin advances is alone sufficient to show the futility of this argument. I allude to the consideration that the power of forming abstract ideas with the complex machinery of language as the vehicle of their expression, is probably of itself enough to account for both the mass and the structure of a savage's brain. But this leads us to the second division of Mr. Wallace's argument, or that derived from the mental endowments of mankind.

Here the peculiarities called into evidence are, "the Mathematical Faculty," "the Artistic Faculties," and "the Moral Sense." With regard to the latter, he avows himself a member of the intuitional school of ethics; but does not prove a very powerful advocate as against the utilitarian.[2]

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[1] The late Professor Mosely informed me that, during his voyage on the *Challenger*, he had seen many men whose backs were well covered with hair.—For an excellent discussion of the whole question, chiefly in the light of embryology, see the paper by Buckman already alluded to, pp. 280–289. Also, for an account of an extraordinary hairy race of men, see *Alone with the Hairy Ainu*, by A. H. Savage Landor, 1893.

[2] E. g. "The special faculties we have been discussing clearly point to the existence in man of something which he has not derived from his animal progenitors —something which we may best refer to as being of a spiritual essence or nature, capable of progressive development under favorable conditions. On the hypothesis of this spiritual nature, superadded to the animal nature of man, we are able to understand much that is otherwise mysterious or unintelligible in regard to him, especially the enormous influence of ideas, principles, and beliefs over his whole life and action. Thus alone can we understand the constancy of the martyr, the unselfishness of the philanthropist, the devotion of the patriot, the enthusiasm of the artist, and the resolute and persevering search of the scientific worker after nature's secrets. Thus we may perceive that the love of truth, the delight in beauty, the passion for justice, and the thrill of exultation with which we hear of any act of courageous self-sacrifice, are the workings within us of a higher nature

It comes, then, to this. According to Mr. Wallace's eventual conclusion, man is to be separated from the rest of organic nature, and the steady progress of evolution by natural causes is to be regarded as stopped at its final stage, because the human mind presents the faculties of mathematical calculation and æsthetic perception. Surely, on antecedent grounds alone, it must be apparent that there is here no kind of proportion between the conclusion and the *data* from which it is drawn. That we are not confined to any such grounds, I will now try to show.

Let it be remembered, however, that in the following brief criticism I am not concerned with the issue as to whether, or how far, the "faculties" in question have owed their origin or their development to *natural selection*. I am concerned only with the doctrine that in order to account for such and such particular "faculty" of the human mind, some order of causation must be supposed other than what we call natural. I am not a Neo-Darwinist, and so have no desire to make "natural selection" synonymous with "natural causation" throughout the whole domain of life and of mind. And I quite agree with Mr. Wallace that, at any rate, the "æsthetic faculty" cannot conceivably have been produced by natural selection—seeing that it is of no conceivable life-serving value in any of the stages of its growth. Moreover, it appears to me that the same thing has to be said of the play instincts, sense of the ludicrous, and sundry other "faculties" of mind among the lower animals. It being thus understood that I am not differing from Mr. Wallace where

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which has not been developed by means of the struggle for material existence." (*Darwinism*, p. 474.) I have quoted this whole paragraph, because it is so inconsistent with the rest of Mr. Wallace's system that a mere epitome of it might well have been suspected of error. Given an intellectual being, howsoever produced, and what is there "mysterious or unintelligible" in "the enormous influence of ideas, principles, and beliefs over his whole life and action"? Or again, if he be also a social being, what is the relevancy of adducing "the constancy of the martyr," "the unselfishness of the philanthropist," "the devotion of the patriot," "the love of truth," "the passion for justice," "the thrill of exultation when we hear of any act of courageous self-sacrifice," in evidence *against* the law of *utility*, or in order to prove that a "nature" thus endowed has "*not* been developed by means of the struggle for existence," when once this struggle has been transferred from individuals to communities? The whole passage reads like an ironical satire in favor of "Darwinism," rather than a serious argument against it.

he imposes "limits" on the powers of natural selection, but only where he seems to take for granted that this is the same thing as imposing limits on the powers of natural causation, my criticism is as follows.

In the first place, it is a psychological fallacy to regard the so-called "faculties" of mind as analogous to "organs" of the body. To classify the latter with reference to the functions which they severally perform is to follow a natural method of classification. But it is an artificial method which seeks to partition mental *faculty* into this, that, and the other mental *faculties*. Like all other purely artificial classifications, this one has its practical uses; but, also like them, it is destitute of philosophical meaning. This statement is so well recognised by psychologists that there is no occasion to justify it. But I must remark that any cogency which Mr. Wallace's argument may appear to present, arises from his not having recognised the fact which the statement conveys. For, had he considered the mind as a whole, instead of having contemplated it under the artificial categories of constituent "faculties," he would probably not have laid any such special stress upon some of the latter. In other words, he would have seen that the general development of the human mind as a whole has presumably involved the growth of those conventionally abstracted parts, which he regards as really separate endowments. Or, if he should find it easier to retain the terms of his metaphor, we may answer him by saying that the "faculties" of mind are "correlated," like "organs" of the body; and, therefore, that any general development of the various other "faculties" have presumably entailed a collateral development of the two in question.

Again, in the second place, it would seem that Mr. Wallace has not sufficiently considered the co-operation of other well-known natural causes, which must have materially assisted the survival of the fittest where these two "faculties" are concerned. For, even if we disregard the inherited effects of use—which, however, if entertained as possible in any degree at all, must have here constituted an important factor,—there remain, on the one hand, the unquestionable influences of individual education, and, on the other hand, of the selection principle operating in the mind itself.

Taking these two points separately, it is surely sufficiently well known that individual education—or special training, whether of mind or body—usually raises congenital powers of any kind to a more or less considerable level above those of the normal type. In other words, whatever doubt there may be touching the *inherited* effects of use, there can be no question touching the immense *developmental* effects thereof in the individual life-time. Now, the conditions of savage life are not such as lead to any deliberate cultivation of the "faculties," either of the mathematical or æsthetic order. Consequently, as might be expected, we find both of them in what Mr. Wallace regards as but a "latent" stage of development. But in just the same way do we find that the marvellous powers of an acrobat when specially trained from childhood—say to curve his spine backwards until his teeth can bite his heels—are "latent" in all men. Or, more correctly, they are *potential in every child.* So it is with the prodigious muscular development of a trained athlete, and with any number of other cases where either the body or the mind is concerned. Why, then, should Mr. Wallace select the particular instances of the mathematical and æsthetic powers in savages as in any special sense "prophetic" of future development in trained members of civilised races? Although it is true that these "latent capacities and powers are unused by savages," is it not equally true that savages fail to use their latent capacities and powers as tumblers and athletes? Moreover, is it not likewise true that *as* used by savages, or as occurring normally in man, such capacities and powers are no less poorly developed than are those of the "faculties" on which Mr. Wallace lays so much stress? In other words, are not "latent capacities and powers" of all kinds more or less equally in excess of anything that is ever required of them by man in a state of nature? Therefore, if we say that where mathematics and the fine arts are concerned the potential capacities of savage man are in some mystical sense "prophetic" of a Newton or a Beethoven, so in consistency ought we to say that in these same capacities we discern a similar prophecy of those other uses of civilised life which we have in a rope-dancer or a clown.

Again, and in addition to this, it should be remembered that, even if we do suppose any prophecy of this kind where the particular capacities in question are concerned, we must clearly extend the reference to the lower animals. Not a few birds display æsthetic feelings in a measure fairly comparable with those of savages; while we know that some animals present the germs of a "faculty" of computation.[1] But it is needless to add, this fact is fatal to Mr. Wallace's argument as I understand it—viz., that the "faculties" in question have been in some special manner communicated by some superior intelligence to *man*.

Once more, it is obviously unfair to select such men as a "Newton, a La Place, a Gauss, or a Cayley" for the purpose of estimating the difference between savages and civilised man in regard to the latter "faculty." These men are the picked mathematicians of centuries. Therefore, they are men who not only enjoyed all the highest possible benefits of individual culture, but likewise those who have been most endowed with mathematical power congenitally. So to speak, they are the best variations in this particular direction which our race is known to have produced. But had such variations arisen among savages, it is sufficiently obvious that they could have come to nothing. Therefore, it is the *normal average* of "mathematical faculty" in civilised man that should be contrasted with that of savage man; and, when due regard is paid to the all-important consideration which immediately follows, I cannot feel that the contrast presents any difficulty to the theory of human evolution by natural causation.

Lastly, the consideration just alluded to is, that civilised man enjoys an advantage over savage man far in advance even of those which arise from a settled state of society, incentives to intellectual training, and so on. This inestimable advantage consists in the art of writing, *and the consequent transmission of the effects of culture from generation to generation.* Quite apart from any question as to the hereditary transmission of acquired characters, we have in this *intellectual* transmission of acquired *experience* a means of accumulative cultivation quite beyond our powers to estimate. For, unlike all other cases where we recognise the great influence of individual use or practice in augmenting congenital "faculties" (such as in the athlete, pianist, etc.), in this case the effects of special cultivation do not end with the individual life, but are carried on and on through successive generations *ad infinitum*. Hence, a civilised man inherits mentally, if not physically, the effects of culture for ages past, and this in whatever direction he may choose to profit therefrom. Moreover—and I deem this an immensely important addition—in this unique department of purely intellectual transmission, a kind of non-physical natural selection is perpetually engaged in producing the best results. For here a struggle for existence is constantly taking place among "ideas," "methods," and so forth, in what may be termed a psychological environment. The less fit are superseded by the more fit, and this not only in the mind of the individual, but, through language and literature, still more in the mind of the race. "A Newton, a La Place, a Gauss, or a Cayley," would all alike have been impossible, but for a previously prolonged course of mental evolution due to the selection principle operating in the region of mathematics, by means of continuous survivals of the best products in successive generations. And, of course, the same remark applies to art in all its branches.[1]

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[1] See *Proceedings Zoölogical Society*, June 4, 1889, for an account of the performances in this respect of the chimpanzee "Sally." Also, for some remarks on the psychology of the subject, in *Mental Evolution in Man*, p. 215. I should like to take this opportunity of stating that, after the two publications above referred to, this animal's instruction was continued, and that, before her death, her "counting" extended as far as ten. That is to say, any number of straws asked for from one to ten would always be correctly given.

Quitting then the last, and in my opinion the weakest chapter of *Darwinism*, the most important points presented by other portions of this work are—to quote its author's own enumeration of them—an attempted "proof that all specific characters are (or once have been) either useful in themselves or correlated with useful characters": an attempted "proof that natural selection can, in certain cases, increase the sterility of crosses": an attempted "proof that the effects of use and disuse even if inherited, must be overpowered by natural selection": an attempted proof that the facts of variation in nature are in themselves sufficient to meet the difficulty which arises against the theory of natural selection, as held by him, from the swamping effects of free inter-crossing: and lastly, "a fuller discussion on the color relations of animals, with additional facts and arguments on the origin of sexual differences of color." It will be sufficient here to remark, that in as far as I disagree with Mr. Wallace (and agree with Darwin), on the subject of "sexual differences of color," my reasons for doing so have been already sufficiently stated in Part I. of *Darwin and After Darwin.* But there is much else in his treatment of this subject which appears to me highly valuable, and therefore presenting an admirable contribution to the literature of Darwinism. In particular, it appears to me that the most important of his views in this connexion probably represents the truth—namely, that, among the higher animals, more or less conspicuous peculiarities of color have often been acquired for the purpose of enabling members of the same species quickly and certainly to recognise one another. This theory was first published by Mr. J. E. Todd, in 1888, and therefore but a short time before its re-publication by Mr. Wallace. As his part in the matter has not been sufficiently recognised, I should like to conclude this article by drawing prominent attention to the merits of Mr. Todd's paper. For not only has it the merit of priority, but it deals with the whole subject of "recognition colors"—or, as he calls them, "directive colors"—in a more comprehensive manner than has been done by any of his successors. In particular, he shows that the principle of recognition-marking is not restricted to facilitating sexual intercourse, but extends also to several other matters of importance in the economy of animal life.[1]

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[1] In Prof. Lloyd Morgan's *Animal Life and Intelligence* there is an admirable discussion on this subject, which has been published since the above was written. The same has to be said of Weismann's essay on music, where much that I have here said is anticipated. With the views and arguments which Mr. Mivart has forcibly set forth I have already dealt to the best of my ability in a work on *Mental Evolution in Man*.

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[1] *American Naturalist,* XXII., pp. 201-207.

Having thus briefly sketched the doctrines of the sundry Post-Darwinian Schools from a general point of view, I shall endeavor in Part II. of *Darwin and After Darwin* to discuss in appropriate detail the questions which have more specially come to the front in the Post-Darwinian period. It can scarcely be said that any one of these questions has arisen altogether *de novo* during this period; for glimmerings, more or less conspicuous, of all are to be met with in the writings of Darwin himself. Nevertheless it is no less true that only after his death have they been lighted up to the full blaze of active discussion.[1] The most important of them are four in number, and it is noteworthy that they are all intimately connected with the great question which Darwin spent the best years of his life in contemplating, and which has therefore, in one form or another, occupied the whole of this article—the question as to whether natural selection has been the sole cause, or but the chief cause of modification.

The four questions above alluded to appertain respectively to heredity, utility, isolation, and physiological selection. Of these the first two will form the subject-matter of my forthcoming volume, while the last two will be dealt with in the final instalment of *Darwin, and After Darwin.*

G. J. ROMANES.

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[1] It is almost needless to say that besides the works mentioned in this article, many others have been added to the literature of Darwinism since Darwin's death. But as none of these profess to contain much that is original, I have not thought it necessary to consider any of them in this merely general review of the period in question.

[Since this note was written and printed the following works have been published to which it does not apply: *Animal Life and Intelligence*, by Prof. Lloyd Morgan; *The Colours of Animals*, by Professor Poulton; *Materials for the Study of Variation*, by Mr. Bateson. All these works are of high value and importance. Special reference should also be made to Professor Weismann's Essays.]